

Exploring Traffic Speed Patterns for the Implementation of Variable Speed Limit (VSL) Signs

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Introduction

Traffic congestion is a prevalent issue during peak hours on United States roads. In growing cities such as Charlotte, North Carolina, efficient congestion management is essential to ensure a good level of service for the mobility of people and goods. Maintaining speed variation below a certain level based on road functional class, time of day, and day of the week is crucial for smooth traffic flow—which, in turn, efficiently and safely gets people and goods where they need to be. This study focuses on identifying road links in Charlotte suitable for implementing variable speed limit (VSL) signs. The objectives are to compute and evaluate traffic speed measures by day of the week and time of the day, to explore their association with the speed limit or reference speed by road functional class, and to provide guidance on identifying road links susceptible to variations in traffic speeds for implementing VSL signs.

Study Methods

Real-world traffic speed data collected over one year (July 2021 to June 2022) was analyzed to identify specific road links with favorable characteristics for VSL sign installation. The speed variations were examined on weekdays and weekends across eight time periods. They were further grouped into five clusters based on the speed limit: 25/30 mph, 35/40 mph, 45/50 mph, 55/60 mph, and 65/70 mph.

Exploratory data analysis on traffic speed data was conducted, focusing on mean, standard deviation, minimum, maximum, 15th percentile speed, and 85th percentile speed. A bivariate analysis was conducted to assess relationships between these statistics. Finally, the difference between the mean speed and the speed limit was computed and categorized into four distinct groups (low speed variation: 0–5 mph; moderate speed variation: >5 mph to ≤10 mph; high speed variation: >10 mph

to ≤ 15 mph; very high speed variation: >15 mph) to identify road links that consistently exhibit high or very high variations in traffic speed throughout the study period.

Standard deviations of speeds on road links with a 45/50 mph speed limit exhibited strong negative correlations with mean, 15th and 85th percentile, and reference speeds.

Findings

Road links with varying speed patterns were identified based on the day of the week, time of the day, and speed limit cluster. The correlations between traffic speed measures and their significance were consistent across weekdays and weekends, regardless of the time of day.

Significant correlations were observed between the mean speed, the 15th percentile speed, the 85th percentile speed, and the reference speed, regardless of the speed limit cluster, indicating a robust relationship among these traffic speed measures. When the mean speed was high, both the 15th and the 85th percentile speeds were high as well.

Road links subject to a 45/50 mph speed limit exhibited a distinct pattern compared to other clusters. The standard deviation of speeds on these links is strongly correlated with the mean, 15th percentile, 85th percentile, and reference speeds. Strong negative correlations implied an inverse relationship, where higher standard deviations of speeds corresponded to lower mean, 15th percentile, 85th percentile, and reference speeds. Conversely, these speed measures tended to increase when the standard deviation of speeds decreased.

Policy/Practice Recommendations

Understanding negative correlations in traffic speed measures informs traffic management and safety. A strong negative correlation between the standard deviation of speeds and mean speed suggests that links with higher variations have lower mean speeds,

indicating driving behavior discrepancies and increased speed fluctuations.

Further, negative correlations between standard deviations of speeds and 15th and 85th percentile speeds and reference speed shed light on speed distribution in the 45/50 mph speed limit cluster. They suggest that increased speed variation leads to lower and higher percentiles and reference speeds. This insight can guide speed management interventions on roads with 45/50 mph speed limits.

About the Authors

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To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/2318



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